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ABSTRACT

A view of the appropriate role of community colleges in the transfer of technology to business and industry is presented in this paper. Introductory material defines technology transfer as a strategy integrating knowledge of the latest technological practices, procedures for their implementation, tactics for their integration into existing delivery systems, and evaluation designs to measure the achievement of technological mastery. Further, the introduction discusses the role of colleges in selecting delivery systems to transfer innovations to business and industry. Next, the technology adaptation project of the National Center for Research in Vocational Education is described. Using Hagerstown Junior College's (HJC's) programs as examples, the following section discusses modes of transferring technology, including: (1) the translation of technical knowledge into information about operational tactics; (2) the installation and application of new hardware; and (3) contracts for the delivery of technological services. After a discussion of the transfer of appropriate technologies to the production setting, barriers to successful transfer (e.g., costs and lack of information) are identified. Finally, strategic issues related to the location of businesses and industries and the level of mastery of previously developed technologies are presented. (HB)

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TECHNOLOGY TRANSFER: PROGRAMS, PROCEDURES, AND PERSONNEL

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Introduction

The seemingly endless advance of American technology creates a unique cluster of challenges for community colleges. The training and development needs of business and industry must be engaged; alternate delivery systems must be designed to increase the effectiveness and efficiency of training and technological upgrading; and, most importantly, appropriate technology must be selected so that local business and industry are able to adopt or adapt to technological change without incurring prohibitive cost.

Technology transfer is a dissemination strategy integrating knowledge of the latest technological practices, procedures for their implementation, tactics for their integration into existing delivery systems, and evaluation designs to measure the achievement of technological mastery. An important distinction between technological innovation and technology transfer is the high cost and risk of the former and the comparably lower cost and risk of the latter. Few community colleges have the resources to be technological innovators. All, however, have the capability of identifying appropriate technological innovations emanating from research and development agencies. The colleges select delivery systems to transfer these innovations to the business and industry community they serve. As Grote suggests, this process "has the potential of increasing our productivity as a nation,..."[1] Yet, the strategy requires careful analysis and planning. If done correctly, a synergy will emerge allowing the college and the business/industry community to profit from the interaction.

Technology Development

The National Center for Research in Vocational Education at Ohio State University co ducted a technology adaptation project during 1982. The outcome of the project was the categorization of high technology development into telecommunications, microcomputer applications, and advanced manufacturing technologies including CAD/CAM and robotics.[2] Further research at the Center indicates that both business/industry and community colleges demonstrate substantial needs for technology upgrading. Yet, both face the lack of financial resources and links with research and development agencies needed for technology upgrading.[3] The research study concludes that planning, cooperation, and resource sharing between the business/

industry community and community colleges can enhance the transfer of newly developed technology.

The potential broker for a national delivery system is the community college. These "grass roots" institutions are already providing programs and services tailored to the unique needs of local business and industry. Sharing of resources, both material and human, to effect technology transfer is a logical next step. Implementation of delivery systems for technology development at the colleges followed by transfer to business/industry through technician training and upgrading is an effective catalytic strategy. The modes for effecting the transfer require creative application of resources and cooperative effort.

Modes of Transfer

Transfer of technology takes place in a variety of ways. The integration of two processes characterizes most strategies: the translation of technical knowledge into information about operational tactics and the implementation of technology through the installation and application of new hardware.[4] Two examples of the integration process at Hagerstown Junior College (HJC) are word processing and computer-assisted design (CAD) simulation. In the former case, instructors from the college attended an intensive, hands-on workshop in word processing technology. The college provided resources for the purchase of a word processing unit. The instructors applied their newly developed knowledge with the new hardware to teach operational tactics for word processing to business/industry employees. In the latter case, an instructor from the college participated in a "return-to-industry" project at a research and development facility using computer-assisted design equipment and processes. After completing the "return to industry," the instructor requested funds from the college to purchase a microcomputer with CAD-simulation capability. Combining newly developed knowledge with new hardware, the instructor disseminates CAD tactics to industry through engineering technician training.

A third mode of transfer is contracting for the delivery of specific technological services with the college by business or industry. HJC has

been involved in microcomputer training for several years. Recently a local industry requested that the college train 160 of their first-line supervisors in the use and application of microcomputers. An instructional team from the college established a microcomputer laboratory at the industry and initiated training. Resources from the industry funded the acquisition and setup of the laboratory.

Finally, some modes of transfer do not require explicit or separate contracts or payments. For example, under Appalachian Regional Commission funding, HJC set up two telecommunication studios. Several industries within the college's service area requested permission to use this equipment to produce video programs. They provided technicians and software while the college provided directors and hardware. The resulting synergy produced product application for industry and technological upgrading for college personnel. The mode used to transfer technology will be dictated by the technology involved, the environment into which it will be transferred and the human resources available. Of equal importance is the selection of appropriate technology.

Appropriate Technology

The major technological transition currently facing American business and industry is characterized by vast diversity. Transfer of new technology from the research and development environment to the production setting often requires substantial changes in working conditions, equipment, and job performance requirements.[5] The cost associated with these changes can be prohibitive if an incorrect technology is selected. Therefore, it is essential that appropriate technology be used rather than the application of a more advanced one which will create insurmountable transfer barriers. For example, the word processing model adopted by HJC can be described as a mid-level technology. After two years of transfer to the local business and industry community, the college is upgrading its technology. The service area is now capable of accepting a higher level of skilled technicians; therefore, the nature of appropriate technology has changed.

Another example of appropriate technology concerns robotics. Four years ago HJC introduced courses in digital principles and circuits and digital and microprocessor applications into its electrical engineering technology curriculum. For the first several years students worked primarily in a laboratory simulation. To actually apply the skills learned in these courses, it was necessary for the students to seek work outside of the college's traditional service area. Recently, sufficient computer-assisted manufacturing and robotic processes have been introduced into the college's business and industry community so that these courses are in heavy demand. Now they represent a technology appropriate for transfer. Colleges must adopt proactive planning strategies that anticipate the technological needs of their service area yet do not expand beyond the capability of business and industry to respond. Such balance will insure that the colleges remain facilitators of the transfer of appropriate technology.

Barriers to Transfer

Recent research into the processes of technology transfer suggests that there are several barriers to be aware of in adopting, developing, then transferring technology.[6] An initial concern is the cost of technological change. The college was able to initiate microcomputer training with local industry only after the price of hardware and software had ceased to be prohibitive from the point of view of the industry.

A second barrier is the difficulty of adopting the new technology at the college due to the lack of information resources. Satellite telecommunications development has been retarded at HJC because the Appalachian Regional Commission redirected its priorities away from this high technology strategy. The college is currently negotiating with the University of Maryland to re-establish the development of satellite telecommunications. If successful, tactics can be developed to transfer this technology into the college's service area.

Finally, perceptions found in the service area or in the college itself that consider remediable shortages to be impossible obstacles can short circuit technology transfer. A recent example is a problem encountered

in the training of robotics technicians. HJC approached the CETA prime sponsor with a proposal to train a group of robotics technicians. There was no difficulty in establishing the employment market for graduates of the program. The college set certain mathematics competencies as minimum entry criteria for the program. The CETA staff perceived the mathematics requirement as an impossible obstacle to recruiting clients for the program. Because CETA held these perceptions, the program did not become a reality under their sponsorship. The college is currently marketing the program to other agencies because the need exists for robotics technicians and the shortage of mathematics-ready clients is temporary and remediable.

Conclusion: Issues of Technology Transfer Strategy

The dependence of a local service area's fund of technological expertise on the mastery of previously developed technologies has important implications. First, decisions about choices of technology and local investment to implement them are critical determinants of the direction in which the service area's technological mastery will develop. Community colleges as agents of technology transfer are central to the mastery process. A staff study prepared for the subcommittee on Monetary and Fiscal Policy of the Joint Economic Committee of the U.S. Congress listed the factors that influence the location choices of high technology companies within regions:

Rank	Attribute	Percent Significant or Very Significant1/
1	Labor skills/availability	89.3
2	Labor costs	72.2
3	Tax climate within the region	67.2
4	Academic institutions	58.7
5	Cost of living	58.5
6	Transportation	58.4
7	Access to markets	58.1
8	Regional regulatory practices	49.0
9	Energy costs/availability	41.4
10	Cultural amenities	36.8
11	Climate	35.8
12	Access to raw materials	27.6

1/ Respondents were asked to rate each attribute as "very significant, significant, somewhat significant, or no significance" with respect to their location choices. The percent of very significant and significant responses were added together to obtain an index of overall importance.

Two of the top five factors involve education. Without access to skilled labor (factor 1) and academic institutions (factor 4), industry tends to locate elsewhere.[7]

The interaction between the business/industry community and the college can develop into a synergistic relationship with technological advances in each prompting new gains for both. It must be remembered, however, there is an important difference between attaining mastery in relation to given circumstances and in developing the capability to adapt to changing circumstances. Thus it is also necessary to develop the capacity to innovate in response to changes in service area needs or demands. The programs, procedures, and personnel of the community college are critical elements of this response system. As Grote suggests, "the responsibility for technology transfer could not only serve as our challenge in the eighties but also could enhance our relationship with the business and industrial community and contribute to the economic development...of the nation."[8]

Footnotes

1. Grote, C. Nelson. "Technology Transfer Extension Service," Community and Junior College Journal, V. 53, No. 4 (December/January 1982-83), p. 14.

2. Faddis, Constance; Ashley, William L.; and Abram, Robert E. Preparing for High Technology: Strategies for Change. Columbus, OH: The National Center for Research in Vocational Education, 1982, pp. 5-16.

3. Hamilton, James B.; Wonacott, Michael E.; and Simandjuntak, Adonia. Technological Update of Vocational Technical Teachers: A Status Report. Columbus, OH: The National Center for Research in Vocational Education, 1982, p. X.

4. Dahlman, Carl J. and Westphal, Larry E. "The Meaning of Technological Mastery in Relation to Transfer of Technology," Technology Transfer: New Issues, New Analysis. Beverly Hills, CA: The Annals of the American Academy of Political and Social Science, Sage Publications, Vol. 458, No. 6 (November 1981), p. 21.

5. Abram, Robert; Ashley, William; Faddis, Constance; and Wiant, Allen. Preparing for High Technology: Programs that Work. Columbus, OH: The National Center for Research in Vocational Education, 1982, p. 1.

6. Pack, Howard. "Appropriate Industrial Technology: Benefits and Obstacles," Technology Trasnfer: New Issues, New Analysis, op. cit., p. 39.

7. Premus, Robert (ed.). "Location of High Technology Firms and Regional Economic Development," A Staff Study prepared for The Subcommittee on Monetary and Fiscal Policy of the Joint Economic Committee, Congress of the United States. Washington, D.C.: U.S. Government Printing Office, 1982.

8. Grote. op. cit., p. 15.

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